Collision Notes and Practice Problems 1st Block 10.6.11

A 0.50 kg object is at rest. A 3.00 N force to the right acts on the object during a time interval of 1.50 s.
a) What is the velocity of the object at the end of this interval?
b) At the end of this interval, a constant force of 4.00 N to the left is aplied for 3.00 s. What is the velocity at the end of the 3.00 s?

a) $F_1 = +3.00\ N$

$m = 0.50\ kg$

$v_{1i} = 0\ m/s$

$v_{1f} = ?$

$\Delta t_1 = 1.5\ s$

$F_1 \Delta t = m \Delta v_1$

$F_1 \Delta t_1 = m(v_{1f} - v_{1i})$

$v_{1f} = \frac{F_1 \Delta t_1}{m}$

$= \frac{(3.00\ N)(1.5\ s)}{(0.50\ kg)}$

$= 9.00\ m/s$

b) $v_{2i} = +9.00\ m/s$

$v_{2f} = ?$

$F_2 = -4.00\ N$

$\Delta t_2 = 3.00\ s$

$m = 0.50\ kg$

$F_2 \Delta t_2 = m \Delta v_2$

$F_2 \Delta t_2 = m(v_{2f} - v_{2i})$

$v_{2f} = \frac{F_2 \Delta t_2}{m} + v_{2i}$

$= \frac{(-4\ N)(3\ s)}{(1.5\ kg)} + 9\ m/s$

$= -15\ m/s$

HW: due Friday, 10/7

p. 201: 1-3

Conservation of Momentum:

$$\bar{P}_i = \bar{P}_f$$

$$\bar{P}_{1i} + \bar{P}_{2i} + \ldots = \bar{P}_{1f} + \bar{P}_{2f} + \ldots$$

Collisions:

- Two types:
  - Perfectly Elastic
    → hit-and-bounce
  - Perfectly ~~In~~elastic
    → hit-and-stick
- Choose our +/- directions
- Rotate our axes to make life easier
- Equations:
  - Perfectly Elastic, 2 objects

$$\bar{P}_{1i} + \bar{P}_{2i} = \bar{P}_{1f} + \bar{P}_{2f}$$

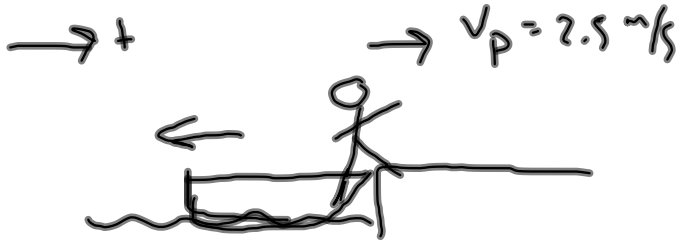
$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

  - Perfectly Inelastic, 2 objects

$$(m_1 + m_2)\bar{v}_i = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = (m_1 + m_2)\bar{v}_f$$

A 76 kg boater, initially at rest in a stationary 45 kg boat, steps out of the boat and onto the dock. If the boater moves out of the boat with a velocity of 2.5 m/s to the right, what is the final velocity of the boat?



$m_p = 75$ kg

$m_b = 45$ kg

$v_i = 0$ m/s

$$(m_p + m_b)\cancel{v_i} = m_p v_{pf} + m_b v_{bf}$$

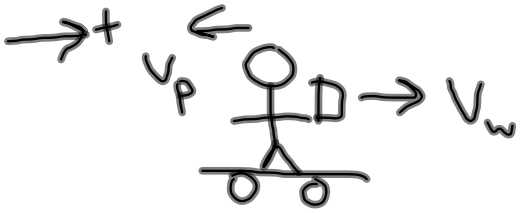
$$m_p v_{pf} = -m_b v_{bf}$$

$$v_{bf} = -\frac{m_p v_{pf}}{m_b}$$

$$= \frac{-(75\text{ kg})(+2.5\text{ m/s})}{(45\text{ kg})}$$

$$= -4.2\text{ m/s}$$

A boy on a 2.0 kg skateboard initially at rest tosses an 8.0 kg jug of water in the forward direction. If the jug has a speed of 3.0 m/s relative to the ground and the boy and skateboard move in the opposite direction at 0.60 m/s, find the mass of the boy.



$$(m_p + m_w)\vec{v}_i^{\,0} = m_p\bar{v}_{pf} + m_w\bar{v}_{wf}$$

$$m_p = \frac{-m_w v_{wf}}{v_{pf}}$$

$$= 38\ kg$$